# Placement in the Course, Teacher Knowledge Skills and Preparation Needed

We have chosen to cover acids and bases at the end of the solutions and solubility unit. Therefore, because this lab is based on that material it is also placed at the end of the unit, a few days before the test. The lab correlates with the big idea that *properties of solutions can be described qualitatively and quantitatively, and can be predicted***.** In the lab, the students determine quantitatively the concentration of a given acid based on its titration with a base of known concentration. The experiment is based on knowledge of the properties of acids and bases.

Teachers need to have a background in acid-base neutralization reactions. They must understand the properties of indicators and their function within labs. Background knowledge of stoichiometry in relation to concentration to volume ratios is also important for this lab. Proper titration skills are also important in this lab as the teacher will need to teach these to the students. Accuracy and precision are important in titration labs. Proper rinsing of the equipment, patient drip-by-drip titration and constant gentle swirling will ensure better results in the lab. As both acids and bases can be irritant it is important that goggles are worn throughout the lab and that teachers ensure students are working with dilute concentrations and small amounts of acid and base solutions. As the final product is a neutral solution, it can be disposed by pouring it into the sink and diluting with tap water. Waste material can be neutralized and disposed of in the same way. If students are splashed with the acid or base they should rinse the affected area immediately with water.

**Sample Data:**

|  |  |  |
| --- | --- | --- |
|  | Vial A Calculations | |
| Volume NaOH (mL) | Concentration of HCl (M) |
| Trial 1 | ***16*** | ***0.1067*** |
| Trial 2 | ***15.2*** | ***0.1013*** |
| Trial 3 | ***14.9*** | ***0.0993*** |

### Group Concentration Results:

|  |  |  |  |
| --- | --- | --- | --- |
| Conc. Vial A (M) | Conc. Vial B (M) | Conc. Vial C (M) | Conc. Vial X (M) |
| ***0.1*** | ***0.2*** | ***0.3*** | ***0.2*** |

**Answers to Pre-Lab Questions**

1. List the characteristics of acids and bases

|  |  |
| --- | --- |
| **Acids** | **Bases** |
| * Contains a proton (H+) * pH less than 7 * corrosive to metals and skin * turns blue litmus paper red * reacts with base to form water and salt * proton donator | * Contains a hydroxide group (OH-) * pH greater than 7 * turns phenolphthalein pink * turns red litmus paper blue * reacts with acid to form water and salt * proton acceptor |

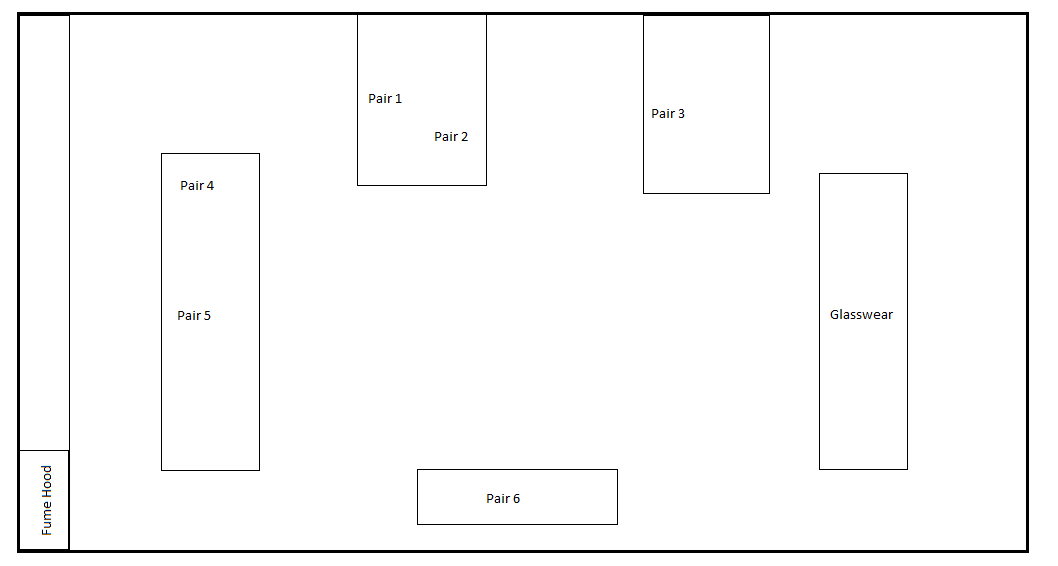
1. Write out the neutralization reaction for NaOH and HCl
2. It takes 20mL of a 2 mol/L solution of NaOH to neutralize 15 mL of an HCl solution of unknown concentration. Use stoichiometry to calculate the concentration of the HCl solution.

**Answers to Post-Lab Questions**

1. The indicator for this lab is phenolphthalein. It is clear in acidic solutions and turns pink in basic solutions. It is used to determine when all the acid has been neutralized by the added base because the solution turns from clear to light pink.
2. The titration stops when all the acid has been used up in reaction with the added base. As seen in the equation for the reaction the products of the reaction is water and salt. Both the products are harmless substances and so we are able to pour the solution down the sink.
3. Titration reactions can be done with a small sample of a solution. It is an easy process that does not require technology or computers to determine concentration. The disadvantages of titration are that you destroy the sample in the process of determining the concentration. You also must perform a series of runs to get an accurate result. You cannot perform a titration unless you have a solution of know concentration for your titrating fluid. If the concentrations between the acid and base are great, you could waste a lot of the titrating fluid trying to determine the unknown concentration.

# Laboratory Set-Up and Diagram

Chemicals will be kept in the fume hood for students collect the small volumes required for the experiment. The burettes will be set up at the lab stations by the teacher prior to the class so that students don’t risk breaking them. Other glassware can be collected from the front of the classroom. Depending on class space and the equipment available, it might be necessary to split the class in two and have each half spend a day performing the lab while the other half engages in seatwork.



**Must-Dos before lab**

* Set up burettes in burette stands (12)
* Prepare acid solutions of specific concentrations:
  + Vial A (0.1M) 500 mL
  + Vial B (0.2M) 500 mL
  + Vial C (0.3M) 500 mL
  + Vial X (0.2M) 500 mL
* Prepare the base solution of NaOH (0.1 M) 3.6 L
* Create and acid-base waste container and place it in the fume hood
* Make sure that all the safety equipment in the classroom are in working condition and that MSDS sheets for NaOH and HCl are on hand.
* Run a practice titration to make sure solutions are accurate
* Set-up supplies at the front of the classroom

|  |  |
| --- | --- |
| Erlenmeyer flasks | 36 |
| Small beakers (150 ml) | 12 |
| Large beakers (500 ml) | 12 |
| Graduated cylinders | 12 |
| Water squirt bottles | 6 |
| Funnels (small) | 12 |
| Safety goggles | 12 |
| Gloves | 1 box |
| Phenolphthalein jars | 6 |

# Assessment/Evaluation of Student Achievement

This labs main goal is to teach students about the titration procedure and the importance accurate results in labs. Students will be observed during the lab and be given descriptive feedback on their lab skills. Some specifics teachers should be looking for is accuracy in measurement, safe procedures, patience in titration. Students will be evaluated on how accurate and precise their results are. This will be based on their concentration calculations and the colour of their final solutions. Students will also be assessed on the pre and post-lab questions.